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(54) Title: ELASTIC LAMINATE EMPLOYING NONWOVEN FORMED BY BI-COMPONENT FIBERS OF ETHYLENE-PROPYLENE RANDOM COPOLYMER

(57) Abstract: The present invention is directed to an elastic laminate. The elastic laminate includes: an elastomeric material layer having a first surface and a second surface opposing the first surface; and a nonwoven layer which is joined to the first surface of the elastomeric material layer to form a laminate. The nonwoven layer includes bi-component fibers having a sheath/core structure. The sheath contains an ethylene-propylene random copolymer which contains from about 7 mol % to about 15 mol % of ethylene comonomer randomly distributed in the polymer backbone. The ethylene-propylene random copolymer has a PEP Ratio of from about 50 mol % to about 100 mol %. The laminate is mechanically stretched to form an elastic laminate. By employing the nonwoven layer of the present invention in the elastic laminate, the elastic laminate provides an improved elongation ability against the mechanical stretching applied thereto during the mechanical stretch process and/or during the use of articles. Consequently, the elastic laminate of the present invention can prevent an undesirable break of the elastic laminate, such as shredding and/or tearing.

ELASTIC LAMINATE EMPLOYING NONWOVEN
FORMED BY BI-COMPONENT FIBERS OF
ETHYLENE-PROPYLENE RANDOM COPOLYMER

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FIELD

The present invention relates to elastic laminates. More specifically, the present invention relates to elastic laminates which employ a nonwoven layer formed by bi-component fibers of a ethylene-propylene random copolymer. The present invention also relates to disposable articles using such an elastic laminate. Examples of such disposable articles include sweat bands, bandages, body wraps, disposable underwears, disposable garments including disposable diapers (adult and baby) including pull-on diapers and training pants, disposable panties for menstrual use, and disposable absorbent pads including sanitary napkins and incontinence devices.

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BACKGROUND

Elastic laminates have previously been used in a variety of disposable products, including sweat bands, bandages, body wraps, disposable underwears, disposable garments including disposable diapers (adult and baby) including pull-on diapers and training pants, disposable panties for menstrual use, and disposable absorbent pads including sanitary napkins and incontinence devices. Herein, "elastic laminate" refers to an elastically stretchable two or more layered materials including at least one elastically stretchable single layer material. It is generally expected that these articles provide good fit to the body and/or skin of the user by using a suitable elastic laminate during the entire use period of products.

A "zero strain" stretch laminate is one type of elastic laminate which is preferably used for such disposable products. For example, methods for making "zero strain" stretch laminate webs are disclosed in U.S. Patent No. 5,167,897 issued to Weber et al. on

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December 1, 1992; U.S. Patent No. 5,156,793 issued to Buell et al. on October 20, 1990; and U.S. Patent No. 5,143,679 issued to Weber et al. on September 1, 1992. In a manufacturing process for such "zero strain" stretch laminate, an elastomeric material is operatively joined to at least one non-elastic component material in a substantially
5 untensioned (zero strain) condition. At least a portion of the resultant non-elastic composite laminate is then subjected to mechanical stretching sufficient to permanently elongate the non-elastic component material. The composite stretch laminate is then allowed to return to its substantially untensioned condition. Thus, the elastic laminate is formed into a "zero strain" stretch laminate. Herein, "zero strain" stretch laminate refers to a laminate
10 comprised of at least two plies of material which are secured to one another along at least a portion of their coextensive surfaces while in a substantially untensioned ("zero strain") condition; one of the plies comprising a material which is stretchable and elastomeric (i.e., will return substantially to its untensioned dimensions after an applied tensile force has been released) and a second ply which is elongatable (but not necessarily elastomeric) so that
15 upon stretching the second ply will be, at least to a degree, permanently elongated so that upon release of the applied tensile forces, it will not fully return to its original undeformed configuration. The resulting stretch laminate is thereby rendered elastically extensible, at least up to the point of initial stretching, in the direction of initial stretching.

As is noted in the above, the manufacturing process of such "zero strain" stretch
20 laminate includes the step of subjecting the non-elastic composite laminate to mechanical stretching sufficient to permanently elongate the non-elastic component material. This step is additional to normal elastic lamination processes and gives limitations to component materials to be used in the elastic laminate. For example, in the case where a nonwoven web is used in the elastic laminate as one of the component materials, it needs to have
25 enough elongation against the mechanical stretching applied since those materials tend to be mechanically damaged by the process. If the nonwoven web does not have enough elongation and thus it is easily damaged, the resultant "zero strain" stretch laminate can not have an expected physical property, resulting in causing an undesirable break of the "zero strain" stretch laminate. For example, such a "zero strain" stretch laminate tends to be
30 easily shred, torn or delaminated by the stress which is applied thereto during the

mechanical stretch process and/or during the use of articles. Therefore, the nonwoven web to be used in the "zero strain" stretch laminate needs to be carefully selected.

Based on the foregoing, there is a need for a "zero strain" stretch laminate that includes a nonwoven layer having an increased elongation ability. There is also a need for a
5 disposable article that employs such an elastic laminate.

SUMMARY

The present invention is directed to an elastic laminate. The elastic laminate includes: an elastomeric material layer having a first surface and a second surface opposing the first surface; and a nonwoven layer which is joined to the first surface of the elastomeric
10 material layer to form a laminate. The nonwoven layer includes bi-component fibers having a sheath/core structure. The sheath contains an ethylene-propylene random copolymer which contains from about 7 mol% to about 15 mol% of ethylene comonomer randomly distributed in the polymer backbone. The ethylene-propylene random copolymer has a PEP Ratio of from about 50 mol% to about 100 mol%. The laminate is mechanically stretched
15 to form an elastic laminate.

The foregoing answers the need for a "zero strain" stretch laminate that includes a nonwoven layer having an increased elongation ability. The foregoing also answers the need for a disposable article that employs such an elastic laminate.

These and other features, aspects, and advantages of the present invention will
20 become evident to those skilled in the art from reading of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

While the specification concludes with claims particularly pointing out and distinctly claiming the invention, it is believed that the invention will be better understood from the following description of preferred embodiments which is taken in conjunction with
25 the accompanying drawings and which like designations are used to designate substantially identical elements, and in which:

Fig. 1 is a perspective view of one preferred embodiment of the disposable pull-on diaper of the present invention in a typical in use configuration;

Fig. 2 is a simplified plan view of the embodiment shown in Fig. 1 in its flat
30 uncontracted condition showing the body-facing side of the garment;

Fig. 3 is a cross-sectional view of a preferred embodiment taken along the section line 3-3 of Fig. 2;

Fig. 4 is a cross-sectional view of an elastic laminate of one preferred embodiment of the present invention;

5 Fig. 5 is a fragmentary enlarged perspective illustration of one preferred example of the elastomeric material layer;

Figs. 6 and 7 are schematic diagrams explaining the measurement for the Surface Roughness of a sample nonwoven;

10 Figs. 8A and 8B are schematic diagrams explaining the measurement for the surface friction of a sample nonwoven;

Fig. 9 shows the conditions of the steel plate used for the Surface Roughness and friction measurements;

Fig. 10 shows the changes of the friction coefficient along the surface of a sample nonwoven;

15 Fig. 11 shows the changes of the thickness along the surface of a sample nonwoven;

Fig. 12 is a plane view of a sample nonwoven used for the shearing property measurement; and

Fig. 13 is a graph showing the shearing property of a sample nonwoven.

DETAILED DESCRIPTION

20 All cited references are incorporated herein by reference in their entireties. Citation of any reference is not an admission regarding any determination as to its availability as prior art to the claimed invention.

Herein, "comprise" and "include" mean that other element(s) and step(s) which do not affect the end result can be added. These terms encompass the terms "consisting of" and
25 "consisting essentially of".

Herein, "pull-on garment" refers to articles of wear which have a defined waist opening and a pair of leg openings and which are pulled onto the body of the wearer by inserting the legs into the leg openings and pulling the article up over the waist.

Herein, "disposable" describes garments which are not intended to be laundered or
30 otherwise restored or reused as a garment (i.e., they are intended to be discarded after a

single use and, preferably, to be recycled, composted or otherwise disposed of in an environmentally compatible manner).

Herein, "pull-on diaper" refers to pull-on garments generally worn by infants and other incontinent individuals to absorb and contain urine and feces. It should be understood, however, that the present invention is also applicable to other pull-on garments such as training pants, incontinent briefs, feminine hygiene garments or panties, and the like.

Herein, "nonwoven" may include any material which has been formed without the use of textile weaving processes which produce a structure of individual fibers which are interwoven in an identifiable manner. Methods of making suitable nonwovens includes a carded nonwoven process, a spunbonded nonwoven process, or the like.

Herein, "panel" denotes an area or element of the pull-on garment. While a panel is typically a distinct area or element, a panel may coincide (functionally correspond) somewhat with an adjacent panel.

Herein, "layer" does not necessarily limit the element to a single strata of material in that a layer may actually comprise laminates or combinations of sheets or webs of the requisite type of materials.

Herein, "joined" or "joining" encompasses configurations whereby an element is directly secured to another by affixing the element directly to the other element, and configurations whereby the element is indirectly secured to the other element by affixing the element to intermediate member(s) which in turn are affixed to the other element.

Herein, "uncontracted state" is used to describe states of pull-on garments in its unseamed (i.e., seams are removed), flat and relaxed condition wherein all elastic materials used are removed therefrom.

As indicated hereinbefore, the elastic laminate of the present invention includes a nonwoven layer joined to a surface of an elastomeric material layer.

The nonwoven layer of the present invention includes bi-component fibers having a sheath/core structure. The sheath contains an ethylene-propylene random copolymer which contains from about 7 mol% to about 15 mol% of ethylene comonomer randomly distributed in the polymer backbone. Preferably, from about 8 mol% to about 12 mol%, more preferably from about 8.5 mol% to about 10 mol% of ethylene comonomer is

randomly distributed in the polymer backbone. In a preferred embodiment, about 8.5 mol% of ethylene comonomer is randomly distributed in the polymer backbone.

The ethylene-propylene random copolymer of the present invention has a PEP Ratio of from about 50 mol% to about 100 mol%. Herein, "PEP Ratio" refers to a mol% of the monomer sequence units of "propylene-ethylene-propylene" among the ethylene-centered triads which are contained in an ethylene-propylene random copolymer. Herein, "triad" refers to a monomer sequence unit including three monomers sequentially bonded in the polymer backbone of a polymer. The triad can be picked up from any portion in the polymer backbone. Herein, "ethylene-centered triad" refers to a triad that contains an ethylene comonomer at least in the center position in the triad. Examples of the ethylene-centered triads include "propylene-ethylene-propylene", "ethylene-ethylene-propylene", and "ethylene-ethylene-ethylene".

Preferably, the ethylene-propylene random copolymer has a PEP Ratio of from about 60 mol% to about 80 mol%. In a preferred embodiment, the ethylene-propylene random copolymer has a PEP Ratio of about 70 mol%.

There can be a variety of analytical methods suitable for determining the PEP Ratio in random copolymers. Any suitable method can be used. A preferred method is the ¹³C Nuclear Magnetic Resonance (NMR) spectroscopy method suggested by M. Kakugo et al. (*Macromolecules* 15, 1150-1152, (1982)). This method is explained in more detail in the Test Method Section.

By employing the nonwoven layer of the present invention in the elastic laminate, the elastic laminate provides an improved elongation ability against the mechanical stretching applied thereto during the mechanical stretch process and/or during the use of articles. Consequently, the elastic laminate of the present invention can prevent an undesirable break of the elastic laminate, such as shredding and/or tearing. Further, the elastic laminate of the present invention can also provide enough abrasion resistance against friction which is generally caused by the wearer's (or user's) movement against adjacent materials. Consequently, the elastic laminate can reduce undesired fuzz occurrence caused by the friction, while providing a soft "cloth-like" looking and a soft/smooth touch.

The ethylene-propylene random copolymer which forms the sheath of the bi-component fibers can be produced by copolymerizing from about 7 mol% to about 15 mol%

of ethylene comonomer with a propylene comonomer so that the ethylene comonomer can be randomly distributed in the polymer backbone of polypropylene.

The core of the bi-component fibers can be formed by any thermoplastic resin material known in the art. In a preferred embodiment, the material preferably used for the
5 core of the bi-component fibers is a polypropylene.

Preferably, the ratio by weight of the sheath to the core of the bi-component fibers is from about 20:80 to about 60:40. In a preferred embodiment, the ratio by weight of the sheath to the core of the bi-component fibers is about 40:60.

The ethylene-propylene random copolymer is less crystalline and thus has a broader
10 melting endotherm range than polypropylene itself. Preferably, the ethylene-propylene copolymer has a melting endotherm range at least between about 80 °C and 165 °C, more preferably between about 60 °C and 185 °C. The broadened melting endotherm range allows for heat bonding of the bi-component fibers over a wider range of nonwoven formation temperature. Thus, the bi-component fibers can be bonded stably through a
15 nonwoven formation process, whereby the abrasion resistance against friction of the resulting nonwoven web can be improved. In addition, since the material used in the core of the bi-component fibers (e.g., polypropylene) can support necessary integrity for the fibers and the resulting nonwoven web, the fuzz level of the resulting nonwoven web can be also reduced.

In a preferred embodiment, the nonwoven layer has a basis weight of less than about
20 40 g/m², and comprises bi-component fibers having an average fiber denier of less than about 2.5. Preferably, for products such as disposable diaper and the like, the nonwoven layer has a basis weight of from about 15 g/m² to about 35 g/m², more preferably from about 20 g/m² to about 30 g/m², and an average fiber denier of less than about 2, and more
25 preferably less than about 1.7.

In a preferred embodiment, the nonwoven layer includes at least about 10% by weight of the bi-component fibers, and supplementary fibers. Herein, "supplementary fibers" are fibers which are different from the bi-component fibers in terms of materials used therein, fiber structure, physical property or dimension, or the like. The supplementary
30 fibers can be any type of fibers known in the art, for example, synthetic fibers (e.g., polymeric fibers such as polyester, polypropylene, or polyethylene fibers), natural fibers

(e.g., wood or cotton fibers), or a combination of natural and synthetic fibers. In a preferred embodiment, the supplementary fibers are mono-component fibers formed by a polypropylene. Preferably, the nonwoven layer includes about 30% by weight of the bi-component fibers and about 70% of the supplementary fibers. More preferably, the nonwoven layer includes more than about 90% by weight of the bi-component fibers. When the nonwoven layer includes the supplementary fibers, the supplementary fibers are mixed or entangled with the bi-component fibers. In a preferred embodiment, the nonwoven layer includes about 100% by weight of the bi-component fibers (i.e., no supplementary fibers included).

10 In a preferred embodiment, the nonwoven layer has an embossment pattern formed by a number of discrete bonding spots or areas. Any embossment process known in the art can be used for forming such an embossment pattern in the nonwoven layer. For example, a preferred embossment pattern is formed by feeding a nonwoven web through two bonding rolls which include a flat roll and an embossing roll which has a raised pattern such as spots or grids on the surface thereof. The bonding rolls are heated to a melting endotherm range of the ethylene-propylene random copolymer of the bi-component fibers. The nonwoven web passes between the heated bonding rolls so that the nonwoven web can be compressed and heated by the bonding rolls in accordance with the pattern on the rolls, thereby forming an embossment pattern of discrete bonding spots or areas in the nonwoven web. The resulting nonwoven web is preferably used as the nonwoven layer. As is well known in the art, the embossment holds the bi-component fibers together and imparts an integrity to the nonwoven web or layer by bonding the bi-component fibers within the nonwoven web or layer.

25 Preferably, the embossment pattern on the embossing roll has an embossment area (or a bonded area) ratio of less than about 20%. In a preferred embodiment, the embossment area ratio of the nonwoven web or layer is from about 7% to about 15%, and more preferably from about 9% to about 13%.

30 In a preferred embodiment, the nonwoven layer has a Surface Roughness of less than about 4 μm , preferably less than about 3.7 μm , and more preferably from about 1.5 μm to about 3.5 μm . The method for measuring the Surface Roughness of nonwoven webs or layers is explained in detail in the Test Method Section.

In a preferred embodiment, the nonwoven layer has a Coefficient of Friction of less than about 0.25, preferably less than about 0.2 and more preferably from about 0.1 to about 0.2. The method for measuring the Coefficient of Friction of nonwoven webs or layers is explained in detail in the Test Method Section.

5 In a preferred embodiment, the nonwoven layer has a Shear Stiffness of at least about 2.5 gf/cm/degree. Preferably, the nonwoven layer has a Shear Stiffness of less than about 2 gf/cm/degree. More preferably, the nonwoven layer has a Shear Stiffness of from about 0.5 gf/cm/degree to about 1 gf/cm/degree. The method for measuring the Shear Stiffness of nonwoven webs or layers is explained in detail in the Test Method Section.

10 In a preferred embodiment, the nonwoven layer has a strain of at least about 80% at the peak in the Stress-Strain curve in the cross-machine direction (CD). Preferably, the nonwoven layer has a strain of at least about 80%, more preferably at least about 100%, and yet more preferably at least about 120% at peak in the Stress-Strain curve in the cross-machine direction. The method for measuring the strain of nonwoven materials at the peak
15 in the Stress-Strain curve is explained in detail in the Test Method Section.

In a preferred embodiment, the nonwoven layer has a stress of less than about 700 gf/inch (about 276 gf/cm) at the peak in the Stress-Strain curve in the cross-machine direction. Preferably, the nonwoven layer has a stress of less than about 500 gf/inch (about 197 gf/cm), more preferably from about 200 gf/inch (about 79 gf/cm) to about 300 gf/inch
20 (about 118 gf/cm) at peak in the Stress-Strain curve in the cross-machine direction. The method for measuring the stress of nonwoven materials at the peak in the Stress-Strain curve is explained in detail in the Test Method Section.

Preferred nonwoven webs which are used for the nonwoven layer of the present invention are available from Kuraray Co., Ltd., Osaka, Japan, under Code Nos. JP4128 and
25 JP4144, and Vliesstoffwerk Christian Heinrich Sandler GmbH & Co. KG, Schwarzenbach/Scale, Germany, under Code Nos. VP22/98/61 and VP22/98/71. These nonwoven webs have the following properties. (The ethylene-propylene random copolymer which forms the sheath of NBF(P-2) fibers contains 8.5 mol% of ethylene comonomer, and has
PEP Ratio of 70 mol%.)

Table

		Nonwoven 1	Nonwoven 2	Nonwoven 3	Nonwoven 4
Nonwoven Supplier and Code	Unit	Kuraray JP4128	Kuraray JP4144	Sandler VP22/98/61	Sandler VP22/98/71
Fiber Supplier, Code and Specification		Daiwabo NBF(P-2) 1.7d x 45mm (100%)	Daiwabo NBF(P-2) 1.7d x 45mm (100%)	Daiwabo NBF(P-2) 1.7d x 45mm (100%)	Daiwabo NBF(P-2) 1.7d x 45mm (30%) FiberVisions HY-Dry T 1.5d x 40mm (70%)
Basis Weight	(g/m ²)	28.2	24.3	27.5	27.3
Mechanical Strength: (5in/min. 1"x5")					
- Stress in CD	(g/in)	270	229	242	288
- Strain in CD	(%)	125	86	107	126
Stiffness/Softness					
-Shear Stiffness	(gf/cm/deg)	2.0	2.0	0.8	0.7
-Coefficient of Friction		0.18	0.18	0.19	0.20
-Surface Roughness (flat roll side)	(micron)	3.44	3.74	3.65	3.55

Fig. 4 is a cross-sectional view of an elastic laminate 70 of one preferred embodiment of the present invention. The elastic laminate 70 includes an elastomeric material layer 124 having a first surface 150 and a second surface 152 opposing the first surface 150, and a first coverstock layer 122 which is joined to the first surface 150 of the elastomeric material layer 124. The first coverstock layer 122 is formed by the nonwoven layer of the present invention. In a preferred embodiment, the first coverstock layer 122 is joined to the first surface 150 of the elastomeric material layer 124 by an adhesive (not shown in Fig. 4). More preferably, the elastic laminate 70 further includes a second coverstock layer 126 which is joined to the second surface 152 of the elastomeric material layer 124 by an adhesive (not shown in Fig. 4). In a preferred embodiment, at least one,

more preferably both of the first and second coverstock layers 122 and 126 is formed by the nonwoven layer of the present invention.

The elastomeric material layer 124 may be formed in a wide variety of sizes, forms and shapes. In a preferred embodiment, the elastomeric material layer 124 is in the form of a continuous plane layer. Preferred forms of continuous plane layer include a scrim, a perforated (or apertures formed) film, an elastomeric woven or nonwoven, and the like. The continuous plane layer may take any shape which can be suitably provided in the ear panels. Preferred shapes of continuous plane layer include a quadrilateral including a rectangle and a square, a trapezoid, and the other polygons. In an alternative embodiment, the elastomeric material layer 124 is in the form of discrete strands (or strings) which are not connected each other.

Elastomeric materials which have been found to be especially suitable for the elastomeric material layer 124 are styrenic block copolymer based scrim materials, perforated (or apertured) elastic films, preferably with a thickness of from about 0.05 mm to about 1.0 mm (0.002 inch - 0.039 inch). Other suitable elastomeric materials for the elastomeric material layer 124 include "live" synthetic or natural rubber, other synthetic or natural rubber foams, elastomeric films (including heat shrinkable elastomeric films), elastomeric woven or nonwoven webs, elastomeric composites, or the like.

In the preferred embodiment shown in Fig. 4, the elastomeric scrim 124 has a plurality of first strands 125 and a plurality of second strands 127. The plurality of first strands 125 intersect the plurality of second strands 127 at nodes 130 at a predetermined angle α , forming a net-like open structure having a plurality of apertures 132. Each aperture 132 is defined by at least two adjacent first strands and at least two adjacent second strands, so that the apertures 132 are substantially rectangular in shape. Other configurations of the apertures 132, such as parallelograms, squares, or circular arc segments, can also be provided. Preferably, the first and second strands 125 and 127 are substantially straight and substantially parallel to one another. Preferably, the first strands 125 intersect the second strands 127 at nodes 130 such that the angle α is about 90 degrees. The first and second strands 125 and 127 are preferably joined or bonded at nodes 90.

A preferred elastomeric scrim 124 is manufactured by the Conwed Plastics Company (Minneapolis, Minn., U.S.A.) under the designation XO2514. This material has

about 12 elastic strands per inch in the structural direction B (i.e., the first strands 125) and about 7 elastic strands per inch in the structural direction D (i.e., the second strands 127).

In an alternative preferred embodiment, the elastomeric material layer 124 is a porous, macroscopically-expanded, three-dimensional elastomeric web. Referring to Fig. 5, the porous, macroscopically-expanded, three-dimensional elastomeric web 172 has a continuous first surface 174 and a discontinuous second surface 176 opposing the first surface 174. The elastomeric web 172 preferably comprises a formed film interconnecting member 186 including at least two polymeric layers 178 and 182. The first layer 178 is substantially elastic and the second layer 182 is substantially less elastic than the first layer 178. At least one of the two polymeric layers 178 and 182 is formed from a polystyrene thermoplastic elastomer. The elastomeric web 172 exhibits a multiplicity of primary apertures 184 in the first surface 174 of the web 172. The primary apertures 184 are defined in the plane of the first surface 174 by a continuous network of the interconnecting member 186. The interconnecting member 186 exhibits an upwardly concave-shaped cross-section along its length. The interconnecting member 186 also forms secondary apertures 188 in the plane of the second surface 176 of the web 172. The apertures 184 and 188 may take any shape. A preferred elastomeric web is disclosed in International Publication No. WO 98/3716 (Curro et al.), published on August 27, 1998. A preferred porous elastomeric material for the elastomeric material layer is available from Tredegar Film Products under the designation X-25007.

In the embodiment shown in Fig. 4, the first coverstock layer 122 has an inner surface 142 and an outer surface 144. The inner surface 142 of the first coverstock layer 122 is the surface that is positioned facing the elastomeric material layer 124. The second coverstock layer 126 also has an inner surface 146 and an outer surface 148. The inner surface 146 of the second coverstock layer 126 is the surface that is positioned facing the elastomeric material layer 124. The first and second surfaces 150 and 152 of the elastomeric material layer 124 are substantially parallel with the planes of the first and second coverstock layers 122 and 126. The first surface 150 is that planar surface of the elastomeric material layer 124 that is most closely adjacent with the inner surface 142 of first coverstock layer 122. The second surface 152 is that planar surface of elastomeric

material layer 124 that is most closely adjacent to the inner surface 146 of the second coverstock layer 126.

Since the elastic laminate 70 will be subjected to mechanical stretching before and during use, the first and second coverstock layers 122 and 126 need to have a relatively high
5 elongation at breaking, and are more preferably stretchable or elongatable, yet more preferably drawable (but not necessarily elastomeric), without undue (and preferably without any), tearing or ripping. Further, the first and second coverstock layers 122 and 126 are preferably compliant, soft feeling, and non-irritating to the wearer's skin and give the article the feel and comfort of a cloth garment. Since at least one of, preferably both the
10 first and second coverstock layers 122 and 126 is formed by the nonwoven layer of the present invention, the elastic laminate 70 meets these requirements and/or preferences.

Preferred nonwoven materials for the first and second coverstock layers 122 and 126 are available from Kuraray Co., Ltd., Osaka, Japan, under Code Nos. JP4128 and JP4144, and from Vliesstoffwerk Christian Heinrich Sandler GmbH & Co. KG,
15 Schwarzenbach/Scale, Germany, under Code Nos. VP22/98/61 and VP22/98/71. These nonwoven webs are already described in detail in Table.

If only one of the first and second coverstock layers 122 and 126 is formed by the nonwoven layer of the present invention, the other of the first and second coverstock layers 122 and 126 is preferably formed by a consolidated nonwoven material which is available
20 from the Fiberweb North America, Inc. (Simpsonville, South Carolina, U.S.A.) under the designation Sofspan 200. Herein, "consolidated nonwoven material" means a nonwoven material that has been gathered or necked under mechanical tension in the structural direction D so that the material can elongate in the structural direction D under low force. This material has a basis weight of 25 g/m² before consolidation and a basis weight of about
25 63g/m² after consolidation. Alternatively, the nonwoven layer of the present invention may be used for the first and second coverstock layers 122 and 126.

The elastomeric material layer 124 and the first and second coverstock layers 122 and 126 are joined together, preferably by using an adhesive, to form the elastic laminate 70. A preferred method for making the elastic laminate 70 is described in International
30 Publication No. WO 98/55298 (Langdon et al.) published on December 10, 1998.

The elastic laminate of the present invention can be applied to a variety of disposable articles in need of a "zero strain" stretch laminate that includes a nonwoven layer having an increased elongation ability. Preferred disposable articles include sweat bands, bandages, body wraps, disposable underwears, disposable garments including disposable
5 diapers (adult and baby) including pull-on diapers and training pants, disposable panties for menstrual use, and disposable absorbent pads including sanitary napkins and incontinence devices. In a preferred embodiment, the present invention can be applied to a disposable garment. In the following, a disposable pull-on diaper will be described in detail as one preferred embodiment of the present invention.

10 Referring to Fig. 1, the disposable pull-on diaper 20 has a front region 26; a back region 28 and a crotch region 30 between the front region 26 and the back region 28. A chassis 41 is provided in the front, back and crotch regions 26, 28 and 30. The chassis 41 includes a liquid pervious topsheet 24, a liquid impervious backsheet 22 associated with the topsheet 24, and an absorbent core 25 (not shown in Fig. 1) disposed between the topsheet
15 24 and the backsheet 22.

The disposable pull-on diaper 20 further includes a pair of front ear panels 46 each extending laterally outward from the corresponding sides of the chassis 41 in the front region 26, and a pair of extensible back ear panels 48 each extending laterally outward from the corresponding sides of the chassis 41 in the back region 28. Each of the ear panels 46
20 and 48 has an outermost edge 240 which forms an outermost edge line 242. At least one of the outermost edge lines 242 has a nonuniform lateral distance LD from the longitudinal center line 100 (not shown in Fig. 1 but in Fig. 2) in the uncontracted state of the garment 20. The pull-on diaper 20 further includes seams 32 each joining the front and back ear panels 46 and 48 along the corresponding edge lines 242 to form the two leg openings 34
25 and the waist opening 36.

In preferred embodiments, the pull-on diaper 20 includes a chassis layer 40 which generally determines the overall shape of the pull-on diaper 20. In the embodiment shown in Fig. 1, the chassis layer 40 is an outer cover nonwoven layer 74 which covers all of the outer-facing surface of the pull-on diaper 20 to provide the feel and appearance of a cloth
30 garment. Preferably, the outer cover nonwoven layer 74 is a continuous sheet or web formed by the nonwoven layer of the present invention. The continuous sheet (i.e., the outer

cover nonwoven layer 74) defines the front region 26, the back region 28 and the crotch region 30 between the front region 26 and the back region 28. Each of the ear panels 46 and 48 includes a portion of the chassis layer 40. Preferred pull-on diapers which includes such a continuous sheet are disclosed in U.S. Patent No. 5,569,234 issued to Buell et al. on
5 October 29, 1996. In a preferred embodiment, the continuous sheet is formed by the nonwoven web which is available from Kuraray Co., Ltd., Osaka, Japan, under Code Nos. JP4128 and JP4144, and Vliesstoffwerk Christian Heinrich Sandler GmbH & Co. KG, Schwarzenbach/Scale, Germany, under Code Nos. VP22/98/61 and VP22/98/71.

In a preferred embodiment, at least one of, more preferably both of, the pairs of the
10 ear panels 46 and 48 are elastically extensible in at least the lateral direction. In alternative embodiments, the ear panels 46 and 48 are elastically extensible both in the lateral and longitudinal directions. Herein, "extensible" refers to materials that are capable of extending in at least one direction to a certain degree without undue rupture. Herein, "elasticity" and "elastically extensible" refer to extensible materials that have the ability to
15 return to approximately their original dimensions after the force that extended the material is removed. Herein, any material or element described as "extensible" may also be elastically extensible unless otherwise provided. The extensible ear panels 46 and 48 provide a more comfortable and contouring fit by initially conformably fitting the pull-on diaper to the wearer and sustaining this fit throughout the time of wear well past when the pull-on diaper
20 has been loaded with exudates since the ear panels 46 and/or 48 allow the sides of the pull-on diaper to expand and contract.

The ear panels 46 and 48 may be formed by unitary elements of the pull-on diaper 20 (i.e., they are not separately manipulative elements secured to the pull-on diaper 20, but rather are formed from and are extensions of one or more of the various layers of the pull-on
25 diaper). In a preferred embodiment, the ear panels 46 and 48 include at least one unitary element or a continuous sheet (e.g. the chassis layer 40) that forms a part of the chassis 41 and continuously extends into the ear panels 46 and 48. Alternatively, the ear panels 46 and 48 may only include discrete members (not shown in Figs.) which do not have any unitary element that also forms a part of the chassis 41. Such an ear panel structure may be formed
30 by joining the discrete members to the corresponding sides of the chassis 41.

In a preferred embodiment, the pull-on diaper 20 further includes seam panels 66 each extending laterally outward from each of the ear panels 46 and 48; and tear open tabs 31 each extending laterally outward from the seam panel 66. In a preferred embodiment, each of the seam panels 66 is an extension of the corresponding ear panels 46 and 48, or at least one of the component elements used therein (e.g., the chassis layer 40), or any other combination of the elements. More preferably, each of the tear open tabs 31 is also an extension of the corresponding seam panel 66 or at least one of its component elements used therein (e.g., the chassis layer 40), or any other combination of its elements.

In a preferred embodiment, the corresponding edge portions of the ear panels 46 and 48 are joined through the seam panels 66 in an overlapping manner to make an overlapped seam structure as shown in Fig. 1. Alternatively, the front and ear panels 46 and 48 can be seamed in a butt seam manner (not shown in Figs.). The bonding of the seams 32 can be performed by any suitable means known in the art appropriate for the specific materials employed in the chassis 41 and/or the ear panels 46 and 48. Thus, sonic sealing, heat sealing, pressure bonding, adhesive or cohesive bonding, sewing, autogeneous bonding, and the like may be appropriate techniques. Preferably, the seam panels 66 are joined by a predetermined pattern of heat/pressure or ultrasonic welds which withstands the forces and stresses generated on the garment 20 during wear.

A continuous belt 38 is formed by the ear panels 46 and 48, and a part of the chassis 41 about the waist opening 36 as shown in Fig. 1. Preferably, elasticized waist bands 50 are provided in both the front region 26 and the back region 28. The continuous belt 38 acts to dynamically create fitment forces in the pull-on diaper 20 when positioned on the wearer, to maintain the pull-on diaper 20 on the wearer even when loaded with body exudates thus keeping the absorbent core 25 (not shown in Fig. 1) in close proximity to the wearer, and to distribute the forces dynamically generated during wear about the waist thereby providing supplemental support for the absorbent core 25 without binding or bunching the absorbent core 25.

Fig. 2 is a partially cut-away plan view of the pull-on diaper 20 of Fig. 1 in its uncontracted state (except in the ear panels 46 and 48 which are left in their relaxed condition) with the topsheet 24 facing the viewer, prior to the ear panels 46 and 48 being joined together by the seams 32. The pull-on diaper 20 has the front region 26, the back

region 28 opposed to the front region 26, the crotch region 30 positioned between the front region 26 and the back region 28, and a periphery which is defined by the outer perimeter or edges of the pull-on diaper 20 in which the side edges are designated 150 and 240, and the end edges or waist edges are designated 152. The topsheet 24 has the body-facing surface of the pull-on diaper 20 which is positioned adjacent to the wearer's body during use. The
5 backsheet 22 has the outer-facing surface of the pull-on diaper 20 which is positioned away from the wearer's body. The pull-on diaper 20 includes the chassis 41 including the liquid pervious topsheet 24, the liquid impervious backsheet 22 associated with the topsheet 24, and the absorbent core 25 positioned between the topsheet 24 and the backsheet 22. The
10 garment 20 further includes the front and back ear panels 46 and 48 extending laterally outward from the chassis 41, the elasticized leg cuffs 52, and the elasticized waistbands 50. The topsheet 24 and the backsheet 22 have length and width dimensions generally larger than those of the absorbent core 25. The topsheet 24 and the backsheet 22 extend beyond the edges of the absorbent core 25 to thereby form the side edges 150 and the waist edges
15 152 of the garment 20. The liquid impervious backsheet 22 preferably includes a liquid impervious plastic film 68.

The pull-on diaper 20 also has two centerlines, a longitudinal centerline 100 and a transverse centerline 110. Herein, "longitudinal" refers to a line, axis, or direction in the plane of the pull-on diaper 20 that is generally aligned with (e.g. approximately parallel
20 with) a vertical plane which bisects a standing wearer into left and right halves when the pull-on diaper 20 is worn. Herein, "transverse" and "lateral" are interchangeable and refer to a line, axis or direction which lies within the plane of the pull-on diaper that is generally perpendicular to the longitudinal direction (which divides the wearer into front and back body halves). The pull-on diaper 20 and component materials thereof also have a body-
25 facing surface which faces the skin of wearer in use and an outer-facing surface which is the opposite surface to the body-facing surface.

While the topsheet 24, the backsheet 22, and the absorbent core 25 may be assembled in a variety of well known configurations, exemplary chassis configurations are described generally in U.S. Patent 3,860,003 entitled "Contractible Side Portions for
30 Disposable Diaper" which issued to Kenneth B. Buell on January 14, 1975; and U.S. Patent 5,151,092 entitled "Absorbent Article With Dynamic Elastic Waist Feature Having A

Predisposed Resilient Flexural Hinge" which issued to Kenneth B. Buell et al., on September 29, 1992.

Fig. 3 is a cross-sectional view of a preferred embodiment taken along the section line 3-3 of Fig. 2. The pull-on diaper 20 includes the chassis 41 including the liquid pervious topsheet 24, the liquid impervious backsheet 22 associated with the topsheet 24, and the absorbent core 25 positioned between the topsheet 24 and the backsheet 22. The pull-on diaper 20 further includes the front ear panels 46 each extending laterally outward from the chassis 41, and an inner barrier cuffs 54. Although Fig. 3 depicts only the structure of the front ear panel 46 and the chassis 41 in the front region 26, preferably a similar structure is also provided in the back region 28. In a preferred embodiment, each of the front ear panels 46 is formed by a lamination of an extended part 72 of the barrier flap 56, an elastic laminate 70 and the outer cover nonwoven layer 74. The elastic laminate 70 includes a plane elastomeric material layer 124 (not shown in Fig. 3). Herein, "plane elastomeric material" refers to elastomeric materials which continuously extend in two dimensional directions. Preferred plane elastomeric materials include a scrim, a perforated (or apertures formed) film, an elastomeric woven or nonwoven, an elastomeric foam and the like. In a preferred embodiment, the plane elastomeric material layer 124 includes at least a portion that has a nonuniform lateral width.

The absorbent core 25 can be any absorbent member which is generally compressible, conformable, non-irritating to the wearer's skin, and capable of absorbing and retaining liquids such as urine and other certain body exudates. The absorbent core 25 may be manufactured in a wide variety of sizes and shapes (e.g., rectangular, hourglass, "T"-shaped, asymmetric, etc.) and from a wide variety of liquid-absorbent materials commonly used in disposable pull-on garments and other absorbent articles such as comminuted wood pulp which is generally referred to as airfelt. Examples of other suitable absorbent materials include creped cellulose wadding; meltblown polymers including coform; chemically stiffened, modified or cross-linked cellulosic fibers; tissue including tissue wraps and tissue laminates; absorbent foams; absorbent sponges; superabsorbent polymers; absorbent gelling materials; or any equivalent material or combinations of materials.

The configuration and construction of the absorbent core 25 may vary (e.g., the absorbent core 25 may have varying caliper zones, a hydrophilic gradient, a superabsorbent gradient, or lower average density and lower average basis weight acquisition zones; or may include one or more layers or structures). Further, the size and absorbent capacity of the absorbent core 25 may also be varied to accommodate wearers ranging from infants through adults. However, the total absorbent capacity of the absorbent core 25 should be compatible with the design loading and the intended use of the garment 20.

A preferred embodiment of the garment 20 has an asymmetric, modified hourglass-shaped absorbent core 25 having ears in the front and back waist regions 26 and 28. Other exemplary absorbent structures for use as the absorbent core 25 that have achieved wide acceptance and commercial success are described in U.S. Patent No. 4,610,678 entitled "High-Density Absorbent Structures" issued to Weisman et al. on September 9, 1986; U.S. Patent No. 4,673,402 entitled "Absorbent Articles With Dual-Layered Cores" issued to Weisman et al. on June 16, 1987; U.S. Patent No. 4,888,231 entitled "Absorbent Core Having A Dusting Layer" issued to Angstadt on December 19, 1989; and U.S. Patent No. 4,834,735, entitled "High Density Absorbent Members Having Lower Density and Lower Basis Weight Acquisition Zones", issued to Alemany et al. on May 30, 1989.

The chassis 41 may further include an acquisition/distribution core 84 of chemically stiffened fibers positioned over the absorbent core 25, thereby forming a dual core system. In a preferred embodiment, the fibers are hydrophilic chemically stiffened cellulosic fibers. Herein, "chemically stiffened fibers" means any fibers which have been stiffened by chemical means to increase stiffness of the fibers under both dry and aqueous conditions. Such means include the addition of chemical stiffening agents which, for example, coat and/or impregnate the fibers. Such means also include the stiffening of the fibers by altering the chemical structure of the fibers themselves, e.g., by cross-linking polymer chains.

The fibers utilized in the acquisition/distribution core 84 can also be stiffened by means of chemical reaction. For example, crosslinking agents can be applied to the fibers which, subsequent to application, are caused to chemically form intrafiber crosslink bonds. These crosslink bonds can increase stiffness of the fibers. Whereas the utilization of

intrafiber crosslink bonds to chemically stiffen the fibers is preferred, it is not meant to exclude other types of reactions for chemical stiffening of the fibers.

In the more preferred stiffened fibers, chemical processing includes intrafiber crosslinking with crosslinking agents while such fibers are in a relatively dehydrated, defibrated (i.e. individualized), twisted, curled condition. Suitable chemical stiffening agents include monomeric crosslinking agents including, but not limited to, C₂-C₈ dialdehydes and C₂-C₈ monoaldehydes having an acid functionality can be employed to form the crosslinking solution. These compounds are capable of reacting with at least two hydroxyl groups in a single cellulose chain or on proximately located cellulose chains in a single fiber. Such crosslinking agents contemplated for use in preparing the stiffened cellulose fibers include, but are not limited to, glutaraldehyde, glyoxal, formaldehyde, and glyoxylic acid. Other suitable stiffening agents are polycarboxylates, such as citric acid. The polycarboxylic stiffening agents and a process for making stiffened fibers from them are described in U.S. Patent No. 5,190,563, entitled "Process for Preparing Individualized, Polycarboxylic Acid crosslinked Fibers" issued to Herron, on March 2, 1993. The effect of crosslinking under these conditions is to form fibers which are stiffened and which tend to retain their twisted, curled configuration during use in the absorbent articles herein. Such fibers, and processes for making them are cited in the above incorporated patents.

Preferred dual core systems are disclosed in U.S. Patent No. 5,234,423, entitled "Absorbent Article With Elastic Waist Feature and Enhanced Absorbency" issued to Alemany et al., on August 10, 1993; and in U.S. Patent No. 5,147,345, entitled "High Efficiency Absorbent Articles For Incontinence Management" issued to Young, LaVon and Taylor on September 15, 1992. In a preferred embodiment, the acquisition/distribution core 84 includes chemically treated stiffened cellulosic fiber material, available from Weyerhaeuser Co. (U.S.A.) under the trade designation of "CMC". Preferably, the acquisition/distribution core 84 has a basis weight of from about 40 g/m² to about 400 g/m², more preferably from about 75 g/m² to about 300 g/m².

More preferably, the chassis 22 further includes an acquisition/distribution layer 82 between the topsheet 24 and the acquisition/distribution core 84 as shown in Fig. 3. The acquisition/distribution layer 82 is provided to help reduce the tendency for surface wetness of the topsheet 24. The acquisition/distribution layer 82 preferably includes carded, resin

bonded hiloft nonwoven materials such as, for example, available as Code No. FT-6860 from Polymer Group, Inc., North America (Landisville, New Jersey, U.S.A.), which is made of polyethylene terephthalate fibers of 6 dtex, and has a basis weight of about 43 g/m². A preferable example for the acquisition/distribution layer 82 and the acquisition/distribution core 84 is disclosed in EP 0797968A1 (Kurt et al.) published on October 1, 1997.

The topsheet 24 is preferably compliant, soft feeling, and non-irritating to the wearer's skin. Further, the topsheet 24 is liquid pervious permitting liquids (e.g., urine) to readily penetrate through its thickness. A suitable topsheet 24 may be manufactured from a wide range of materials such as woven and nonwoven materials; polymeric materials such as apertured formed thermoplastic films, apertured plastic films, and hydroformed thermoplastic films; porous foams; reticulated foams; reticulated thermoplastic films; and thermoplastic scrims. Suitable woven and nonwoven materials can be included of natural fibers (e.g., wood or cotton fibers), synthetic fibers (e.g., polymeric fibers such as polyester, polypropylene, or polyethylene fibers) or from a combination of natural and synthetic fibers. The topsheet 24 is preferably made of a hydrophobic material to isolate the wearer's skin from liquids which have passed through the topsheet 24 and are contained in the absorbent core 25 (i.e., to prevent rewet). In a preferred embodiment, the topsheet 24 is formed by the nonwoven layer of the present invention. If the topsheet 24 is made of a hydrophobic material, at least the upper surface of the topsheet 24 is treated to be hydrophilic so that liquids will transfer through the topsheet more rapidly. This diminishes the likelihood that body exudates will flow off the topsheet 24 rather than being drawn through the topsheet 24 and being absorbed by the absorbent core 25. The topsheet 24 can be rendered hydrophilic by treating it with a hydrophobic finishing oil or a surfactant. Suitable methods for the treatment for the topsheet 24 include spraying the topsheet 24 material with the surfactant and immersing the material into the surfactant. A more detailed discussion of such a treatment and hydrophilicity is contained in U.S. Patent No. 4,988,344 entitled "Absorbent Articles with Multiple Layer Absorbent Layers" issued to Reising, et al. on January 29, 1991 and U.S. Patent No. 4,988,345 entitled "Absorbent Articles with Rapid Acquiring Absorbent Cores" issued to Reising on January 29, 1991. Alternatively, the topsheet 24 may be a carded nonwoven material which is formed by hydrophilic component fibers.

In a preferred embodiment, the topsheet 24 is a nonwoven web that can provide reduced tendency for surface wetness; and consequently facilitate maintaining urine absorbed by the core 25 away from the user's skin, after wetting. One of the preferred topsheet materials is a thermobonded carded web which is available as Code No. P-8 from
5 Fiberweb North America, Inc. (Simpsonville, South Carolina, U.S.A.). Another preferred topsheet material is available as Code No. S-2355 from Havix Co., Japan. This material is a bi-layer composite material, and made of two kinds of synthetic surfactant treated bi-component fibers by using carding and air-through technologies. Yet another preferred topsheet material is a thermobonded carded web which is available as Code No. Profleece
10 Style 040018007 from Amoco Fabrics, Inc. (Gronau, Germany).

Another preferred topsheet 24 includes an apertured formed film. Apertured formed films are preferred for the topsheet 24 because they are pervious to body exudates and yet non-absorbent and have a reduced tendency to allow liquids to pass back through and rewet the wearer's skin. Thus, the surface of the formed film which is in contact with the body
15 remains dry, thereby reducing body soiling and creating a more comfortable feel for the wearer. Suitable formed films are described in U.S. Patent No. 3,929,135, entitled "Absorptive Structures Having Tapered Capillaries", issued to Thompson on December 30, 1975; U.S. Patent No. 4,324,246 entitled "Disposable Absorbent Article Having A Stain Resistant Topsheet", issued to Mullane, et al. on April 13, 1982; U.S. Patent No. 4,342,314
20 entitled "Resilient Plastic Web Exhibiting Fiber-Like Properties", issued to Radel, et al. on August 3, 1982; U.S. Patent No. 4,463,045 entitled "Macroscopically Expanded Three-Dimensional Plastic Web Exhibiting Non-Glossy Visible Surface and Cloth-Like Tactile Impression", issued to Ahr et al. on July 31, 1984; and U.S. 5,006,394 "Multilayer Polymeric Film" issued to Baird on April 9, 1991.

25 In a preferred embodiment, the backsheet 22 includes the liquid impervious film 68. Preferably, the liquid impervious film 68 longitudinally extends in the front, back and crotch regions 26, 28 and 30 as shown in Fig. 2. More preferably, the liquid impervious film 68 does not laterally extend into the at least one of the ear panels 46 or 48. Referring again to Fig. 3, the liquid impervious film 68 has a body-facing surface 79 and an outer-
30 facing surface 77 opposing the body-facing surface 79. The liquid impervious film 68 is impervious to liquids (e.g., urine) and is preferably manufactured from a thin plastic film.

However, more preferably the plastic film permits vapors to escape from the garment 20. In a preferred embodiment, a microporous polyethylene film is used for the liquid impervious film 68. A suitable microporous polyethylene film is manufactured by Mitsui Toatsu Chemicals, Inc., Nagoya, Japan and marketed in the trade as PG-P. In a preferred embodiment, a disposable tape (not shown in Figs.) is additionally joined to the outer surface of the backsheet 22 to provide a convenient disposal after soiling. A preferred disposal tape (or device) for pull-on garments is disclosed in International Publication No. WO 94/09736 (Rollag et al.) published on May 11, 1994.

A suitable material for the liquid impervious film 68 is a thermoplastic film having a basis weight of from about 10 g/m² to about 45 g/m². Preferably, the thermoplastic film has a basis weight of from about 25 g/m² to about 40 g/m². In a preferred embodiment, the thermoplastic film has a basis weight of about 35 g/m².

The backsheet 22 further includes the outer cover nonwoven layer 74 (i.e., the chassis layer 40) which is joined with the outer-facing surface 77 of the liquid impervious film 68 to form a laminate. Preferably, the outer cover nonwoven layer 74 is formed by the nonwoven layer of the present invention. The outer cover nonwoven layer 74 preferably covers all of the outer-facing surface of the pull-on diaper 20 to provide the feel and appearance of a cloth garment. The outer cover nonwoven layer 74 may be joined to the liquid impervious film 68 by any suitable attachment means known in the art. For example, the outer cover nonwoven layer 74 may be secured to the liquid impervious film 68 by a uniform continuous layer of adhesive, a patterned layer of adhesive, or an array of separate lines, spirals, or spots of adhesive. Suitable adhesives include a hotmelt adhesive obtainable from Nitta Findley Co., Ltd., Osaka, Japan as H-2128, and a hotmelt adhesive obtainable from H.B. Fuller Japan Co., Ltd., Osaka, Japan as JM-6064.

In a preferred embodiment, the outer cover nonwoven layer 74 is formed by the nonwoven web which is available from Kuraray Co., Ltd., Osaka, Japan, under Code Nos. JP4128 and JP4144, and Vliesstoffwerk Christian Heinrich Sandler GmbH & Co. KG, Schwarzenbach/Scale, Germany, under Code Nos. VP22/98/61 and VP22/98/71.

The backsheet 22 is positioned adjacent the outer-facing surface of the absorbent core 25 and is preferably joined thereto by any suitable attachment means known in the art. Specifically, the body-facing surface 79 of the liquid impervious film 68 may be secured to

the absorbent core 25 by a uniform continuous layer of adhesive, a patterned layer of adhesive, or an array of separate lines, spirals, or spots of adhesive. Adhesives which have been found to be satisfactory are manufactured by H. B. Fuller Company of St. Paul, Minnesota, U.S.A., and marketed as HL-1358J. An example of a suitable attachment means including an open pattern network of filaments of adhesive is disclosed in U.S. Patent No. 4,573,986 entitled "Disposable Waste-Containment Garment", which issued to Minetola et al. on March 4, 1986. Another suitable attachment means including several lines of adhesive filaments swirled into a spiral pattern is illustrated by the apparatus and methods shown in U.S. Patent No. 3,911,173 issued to Sprague, Jr. on October 7, 1975; U.S. Patent No. 4,785,996 issued to Ziecker, et al. on November 22, 1978; and U.S. Patent No. 4,842,666 issued to Werenicz on June 27, 1989. Alternatively, the attachment means may include heat bonds, pressure bonds, ultrasonic bonds, dynamic mechanical bonds, or any other suitable attachment means or combinations of these attachment means as are known in the art.

In an alternative embodiment, the absorbent core 25 is not joined to the backsheet 22, and/or the topsheet 24 in order to provide greater extensibility in the front region 26 and the back region 28.

The pull-on diaper 20 preferably further includes elasticized leg cuffs 52 for providing improved containment of liquids and other body exudates. The elasticized leg cuffs 52 may include several different embodiments for reducing the leakage of body exudates in the leg regions. (The leg cuffs can be and are sometimes also referred to as leg bands, side flaps, barrier cuffs, elastic cuffs or gasketing cuffs.) U.S. Patent 3,860,003 entitled "Contractable Side Portions for Disposable Diaper" issued to Buell on January 14, 1975, describes a disposable diaper which provides a contractible leg opening having a side flap and one or more elastic members to provide an elasticized leg cuff. U.S. Patent 4,909,803 entitled "Disposable Absorbent Article Having Elasticized Flaps" issued to Aziz et al. on March 20, 1990, describes a disposable diaper having "stand-up" elasticized flaps (barrier cuffs) to improve the containment of the leg regions. U.S. Patent 4,695,278 entitled "Absorbent Article Having Dual Cuffs" issued to Lawson on September 22, 1987; and U.S. Patent 4,795,454 entitled "Absorbent Article Having Leakage-Resistant Dual Cuffs" issued to Dragoo on January 3, 1989, describe disposable diapers having dual cuffs including a

gasketing cuff and a barrier cuff. U.S. Patent 4,704,115 entitled "Disposable Waist Containment Garment" issued to Buell on November 3, 1987, discloses a disposable diaper or incontinence garment having side-edge-leakage-guard gutters configured to contain free liquids within the garment. In a preferred embodiment, such barrier cuffs or "stand-up" elasticized flaps are formed by the nonwoven layer of the present invention.

While each elasticized leg cuff 52 may be configured so as to be similar to any of the leg bands, side flaps, barrier cuffs, or elastic cuffs described above, it is preferred that the elasticized leg cuff 52 includes an elastic gasketing cuff 62 with one or more elastic strands 64 as shown in Fig. 2, which is described in the above-referred U.S. Patent Nos. 4,695,278 and 4,795,454. It is also preferred that each elasticized leg cuff 52 further includes inner barrier cuffs 54 each including a barrier flap 56 and a spacing means 58 which are described in the above-referenced U.S. Patent No. 4,909,803.

The pull-on diaper 20 preferably further includes an elasticized waistband 50 that provides improved fit and containment. The elasticized waistband 50 is that portion or zone of the pull-on diaper 20 which is intended to elastically expand and contract to dynamically fit the wearer's waist. The elasticized waistband 50 preferably extends longitudinally outwardly from the waist edge of the pull-on diaper 20 toward the waist edge of the absorbent core 25. Preferably, the pull-on diaper 20 has two elasticized waistbands 50, one positioned in the back region 28 and one positioned in the front region 26, although other pull-on garment embodiments can be constructed with a single elasticized waistband. The elasticized waistband 50 may be constructed in a number of different configurations including those described in U.S. Patent 4,515,595 entitled "Disposable Diapers with Elastically Contractible Waistbands" issued to Kievit et al. on May 7, 1985 and the above referenced U.S. Patent 5,151,092 issued to Buell.

The waistbands 50 may include materials that have been "prestrained" or "mechanically prestrained" (i.e., subjected to some degree of localized pattern mechanical stretching to permanently elongate the material). In a preferred embodiment, the nonwoven of the present invention can be used in one of the component materials used in the waistbands 50. Alternatively, the materials may be prestrained by directing the material through an incremental mechanical stretching system as described in U.S. Patent No. 5,330,458 entitled "Absorbent Article With Elastic Feature Having A Portion Mechanically

Prestrained" issued to Buell et al., on July 19, 1994. The materials are then allowed to return to their substantially untensioned condition, thus forming a "zero strain" stretch laminate that is extensible, at least up to the point of initial stretching. Examples of "zero strain" laminate are described hereinafter. In a preferred embodiment, the elasticized waistband 50 includes the elastic laminate of the present invention.

At least one pair of the ear panels 46 and 48 includes the elastic laminate 70 as shown in Fig. 3. In a preferred embodiment, at least one pair of the ear panels 46 and 48 includes the elastic laminate of the present invention. The elastic laminate 70 of the front ear panels 46 includes an elastomeric material layer 124 (not shown in Fig. 3 but Fig. 4) which preferably extends laterally outward from the chassis 41 to provide good fitness by generating the optimal retention (or sustained) force at the waist and side areas of the wearer. Preferably, the elastomeric material layer 124 is extensible in at least one direction, preferably in the lateral direction to generate a retention (or sustained) force that is optimal to prevent the pull-on diaper 20 from drooping, sagging, or sliding down from its position on the torso without causing the red marking on the skin of the wearer. In a preferred embodiment, each of the ear panels 46 and 48 includes the elastomeric material layer 124.

The elastic laminate 70 is operatively joined to the outer cover nonwoven layer 74 and preferably the nonwoven webs 72 in the ear panels 46 and 48 to form a laminate. In a preferred embodiment, the elastic laminate 70 is operatively joined to the nonwoven webs 72 and 74 by securing them to at least one, preferably both of the nonwoven webs 72 and 74 while in a substantially untensioned (zero strain) condition.

The elastic laminate 70 can be operatively joined to the nonwoven webs 72 and 74, by using either an intermittent bonding configuration or a substantially continuous bonding configuration. Herein, "intermittently" bonded laminate web means a laminate web wherein the plies are initially bonded to one another at discrete spaced apart points or a laminate web wherein the plies are substantially unbonded to one another at discrete spaced apart areas. Conversely, a "substantially continuously" bonded laminate web means a laminate web wherein the plies are initially bonded substantially continuously to one another throughout the areas of interface. It is preferred that the stretch laminate be bonded over all or a significant portion of the stretch laminate so that the inelastic webs (i.e., the nonwoven webs 72 and 74) elongate or draw without causing rupture, and the layers of the stretch laminates

are preferably bonded in a configuration that maintains all of the layers of the stretch laminate in relatively close adherence to one another after the incremental mechanical stretching operation. Consequently, the elastic panel members and the other plies of the stretch laminate are preferably substantially continuously bonded together using an adhesive. In a particularly preferred embodiment, the adhesive selected is applied with a control coat spray pattern at a basis weight of about 7.0 grams/m². The adhesive pattern width is about 6.0 cm. The adhesive is preferably an adhesive such as is available from Nitta Findley Co., Ltd., Osaka, Japan, under the designation H2085F. Alternatively, the elastic panel member and any other components of the stretch laminates may be intermittently or continuously bonded to one another using heat bonding, pressure bonding, ultrasonic bonding, dynamic mechanical bonding, or any other method as is known in the art.

After the elastic laminate 70 is operatively joined to the nonwoven webs 72 and 74, at least a portion of the resultant composite stretch laminate is then subjected to mechanical stretching sufficient to permanently elongate the non-elastic components which are, for example, the nonwoven webs 72 and 74. The composite stretch laminate is then allowed to return to its substantially untensioned condition. At least one pair of, preferably both of the ear panels 46 and 48 is thus formed into "zero strain" stretch laminates. This configuration allows the ear panels 46 and 48 to be elastically extensible in at least the lateral direction.

A "zero strain" stretch laminate is one type of elastic laminate which is preferably used for such disposable products. For example, methods for making "zero strain" stretch laminate webs are disclosed in U.S. Patent No. 5,167,897 issued to Weber et al. on December 1, 1992; U.S. Patent No. 5,156,793 issued to Buell et al. on October 20, 1990; and U.S. Patent No. 5,143,679 issued to Weber et al. on September 1, 1992. In a manufacturing process for such "zero strain" stretch laminate, an elastomeric material is operatively joined to at least one non-elastic component material in a substantially untensioned (zero strain) condition. At least a portion of the resultant non-elastic composite stretch laminate is then subjected to mechanical stretching sufficient to permanently elongate the non-elastic component material. The composite stretch laminate is then allowed to return to its substantially untensioned condition. Thus, the elastic laminate is formed into a "zero strain" stretch laminate. Herein, "zero strain" stretch laminate refers to a

laminate comprised of at least two plies of material which are secured to one another along at least a portion of their coextensive surfaces while in a substantially untensioned ("zero strain") condition; one of the plies comprising a material which is stretchable and elastomeric (i.e., will return substantially to its untensioned dimensions after an applied tensile force has been released) and a second ply which is elongatable (but not necessarily elastomeric) so that upon stretching the second ply will be, at least to a degree, permanently elongated so that upon release of the applied tensile forces, it will not fully return to its original undeformed configuration. The resulting stretch laminate is thereby rendered elastically extensible, at least up to the point of initial stretching, in the direction of initial stretching.

The elastic laminate 70 is preferably joined to, more preferably directly secured to the respective edges 78 of the liquid impervious film (i.e., the liquid impervious film 68) through an adhesive 76 as shown in Fig. 3. In a preferred embodiment, while liquid impervious film 68 longitudinally extends in the front, back and crotch regions 26, 28 and 30, it does not laterally extend into at least one of, preferably each of the extensible ear panels 46 and 48. In a more preferred embodiment, the elastic laminate 70 is joined to the respective edges 78 of the liquid impervious film 68 at the outer-facing surface 77 as shown in Fig. 3. In an alternative embodiment, the elastic laminate 70 may be joined to the respective edges 78 of the liquid impervious film 68 at the body-facing surface 79. Preferably, the adhesive 76 is applied in a spiral glue pattern. In a preferred embodiment, the adhesive 76 is a flexible adhesive with an amorphous and crystallizing component. Such a preferred adhesive is made by Nitta Findley Co., Ltd., Osaka, Japan, under the designation H2085F. Alternatively, the elastic laminate 70 may be joined to the respective edges 78 of the liquid impervious film 68 by any other bonding means known in the art which include heat bonds, pressure bonds, ultrasonic bonds, dynamic mechanical bonds, or combinations of these attachment means.

TEST METHODS

1. PEP Ratio

A sample of random copolymer is dissolved in a solvent of 1,2-dichlorobenzene to prepare 5% weight per volume of solution. The sample can be any form of the material to be analyzed, for example, a chip of resin, fibers, or a piece of nonwoven. Benzene-d6 is

added to the solution for capturing a lock signal, and tetramethylsilane is also added as an internal chemical shift reference (e.g., 0 ppm). The solution is analyzed by a Nuclear Magnetic Resonance (NMR) Spectrometer to obtain ^{13}C NMR spectra. A preferred NMR Spectrometer is commercially available from JEOL Co. Ltd., Tokyo, Japan, under Trade Name "Lambda 500". The analysis is preferably conducted under the following conditions:

Frequency: 125,778 MHz

Measurement Temperature: 100 °C

Number of Transients Accumulated: 500 - 1000

2. Surface Roughness and Coefficient of Friction

To measure the Surface Roughness of the specimen (i.e., a nonwoven layer), a pianowire is prepared and bent as shown in Figs. 6 and 7. 10 gf of the contact force is applied by a spring of which spring constant is 25 gf/mm.

The friction between the surfaces of the specimen and a contactor is measured under a constant contact pressure. The contactor includes ten parallel and stacked piano steel wires such that those form the outer surface of the contactor as shown in Figs. 8A and 8B. The contactor is placed on the surface of specimen. The compressional force of 50 gf by dead weight is applied to the surface of the specimen through the contactor.

In the both of the roughness and friction measurements, the specimen is moved back and forth between the interval 3 cm by a constant velocity of 0.1 cm/sec on a smooth steel plate placed horizontally where the tension of the specimen is kept 10 gf/cm (force per unit length) and the contactor is kept its position. The dimension of the plate is shown in Fig. 9. As a result, the changes of the surface friction coefficient μ and the thickness T of the specimen are obtained as shown in Figs. 10 and 11, respectively. The data obtained at the middle of the movement (i.e., from $x = 0.5$ cm to $x = 2.5$ cm) is considered for the calculation below to avoid picking up unstable data which may be generated in the transition states of the movement of the specimen.

Consequently, the average values of Surface Roughness (SR) and Coefficient of Friction (COF) are obtained from the following expressions:

$$\text{SR} = \frac{1}{2} \int_{0.5}^{2.5} |T - T'| dx, \quad \text{--- (1)}$$

$$\text{COF} = \frac{1}{2} \int_{0.5}^{2.5} \mu dx, \quad \text{--- (2)}$$

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where μ ; frictional force/compressional force

x ; displacement of the contactor on the surface of specimen

T ; Thickness of the specimen at position x

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T' ; Mean value of T

A preferred equipment for the measurements of the Surface Roughness and the Coefficient of Friction is commercially available from Kato Tech Co., Ltd., Kyoto, Japan, under the trade name "Surface Tester KES-FB4".

3. Shear Stiffness

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The constant extension force, 5 gf/cm, is applied to the sample uni-directional and then the shear force F_s is superposed in the sample plane along the transverse direction up to the shear angle $\theta = 4^\circ$ as shown in Fig. 12. Then, the sample shear deformation is recovered by reducing the shear angle back to zero. The effective dimension of the sample is 20 cm in width and 5 cm in length. Thus, the relationship between F_s and θ is obtained as shown in

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Fig. 13. The value of G is calculated as follows:

$$G = (G_f + G_b) / 2 \quad \text{--- (3)}$$

G_f is the Shear Stiffness which is obtained from the average slope of the shear force F_s between $\theta = 0.5^\circ$ and 2.5° when a shear force is applied to the sample in one direction (i.e., the forward direction FD in Fig. 12). G_b is the average slope of the shear force F_s between $\theta = -0.5^\circ$ and -2.5° , when a shear force is applied to the sample in the other

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direction (i.e., the back direction BD in Fig. 12).

A preferred equipment for the measurements of the Shear Stiffness is commercially available from Kato Tech Co., Ltd., Kyoto, Japan, under the trade name "Tensile & Shear Tester KES-FB1".

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4. Tensile Strength Property

The following method is preferably used to measure the tensile strength property (i.e., the strain and the stress) of nonwoven materials.

A tensile tester is prepared. The tensile tester has an upper jaw and a lower jaw which is located below the upper jaw. The upper jaw is movable and is connected to an extension force measuring means. The lower jaw is fixed in the tester. A test specimen (i.e., a nonwoven material to be measured) which has about 2.5 cm (about 1 inch) in width and about 17.8 cm (about 7 inches) in length is prepared and clamped with the upper jaw and the lower jaw so that the effective specimen length (L) (i.e., gauge length) is about 12.7 cm (about 5 inch). An extension force is continuously applied to the test specimen through the upper jaw at a cross-head speed of about 12.7 cm (about 5 inches) per minute, until the test specimen is physically broken. The applied extension force (i.e., the stress) and the elongation (i.e., the strain) of the specimen are recorded by a recorder (e.g., a computer system), thereby obtaining a Stress-Strain curve. A tensile tester suitable for use is available from Instron Corporation (100 Royall Street, Canton, MA02021, U.S.A.) as Code No. Instron 5564. It is understood that the examples and embodiments described herein are for illustrative purpose only and that various modifications or changes will be suggested to one skilled in the art without departing from the scope of the present invention.

WHAT IS CLAIMED IS:

1. An elastic laminate elastically extensible in at least one direction, comprising:
an elastomeric material layer having a first surface and a second surface opposing the first surface; and
a nonwoven layer joined to the first surface of the elastomeric material layer to form
5 a laminate, the nonwoven layer including bi-component fibers having a sheath/core structure, the sheath containing an ethylene-propylene random copolymer which contains from about 7 mol% to about 15 mol% of ethylene comonomer randomly distributed in the polymer backbone, the ethylene-propylene random copolymer having a PEP Ratio of from about 50 mol% to about 100 mol%;
10 the laminate being mechanically stretched to form an elastic laminate.
2. The elastic laminate of Claim 1, wherein the nonwoven layer has a strain of at least about 80% at the peak in the Stress-Strain curve in the cross-machine direction.
3. The elastic laminate of Claim 2, wherein the nonwoven layer has a stress of less than about 700 gf/inch (about 276 gf/cm) at peak in the Stress-Strain curve in the cross-machine direction.
4. The elastic laminate of Claim 1, wherein the nonwoven layer includes at least 10% by weight of the bi-component fibers.
5. The elastic laminate of Claim 1, wherein the nonwoven layer has a Coefficient of Friction of less than about 0.25.
6. The elastic laminate of Claim 1, wherein the nonwoven layer has a Surface Roughness of less than about 4 μm .

7. The elastic laminate of Claim 1, wherein the elastomeric material layer includes an elastomeric material which has plurality of apertures formed therein.
8. A disposable article comprising the elastic laminate of Claim 1.
9. The disposable article of Claim 8, wherein the disposable article is a disposable garment including at least one pair of extensible ear panels, and wherein at least one of the side panels includes the elastic laminate of Claim 1.
10. The elastic laminate of Claim 8, wherein the disposable article is a disposable garment including a waistband, wherein the waistband includes the elastic laminate of Claim 1.

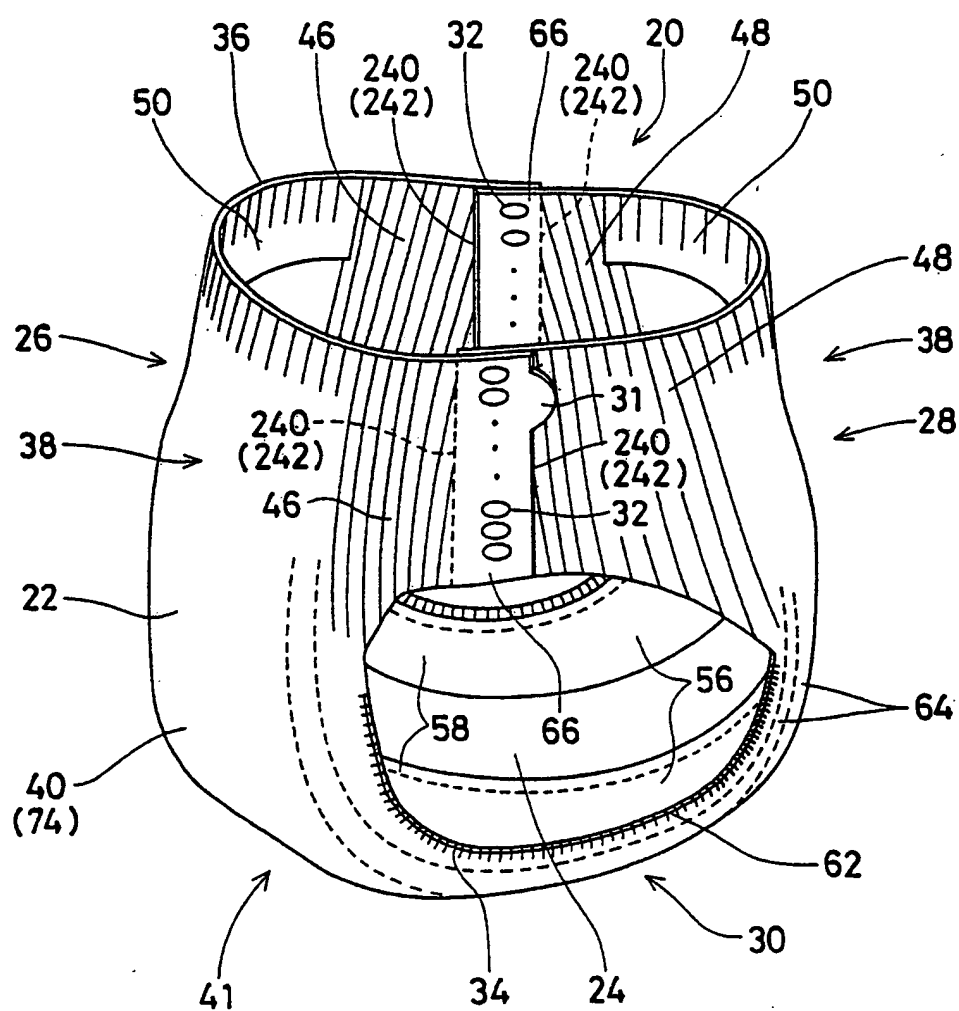


Fig. 1

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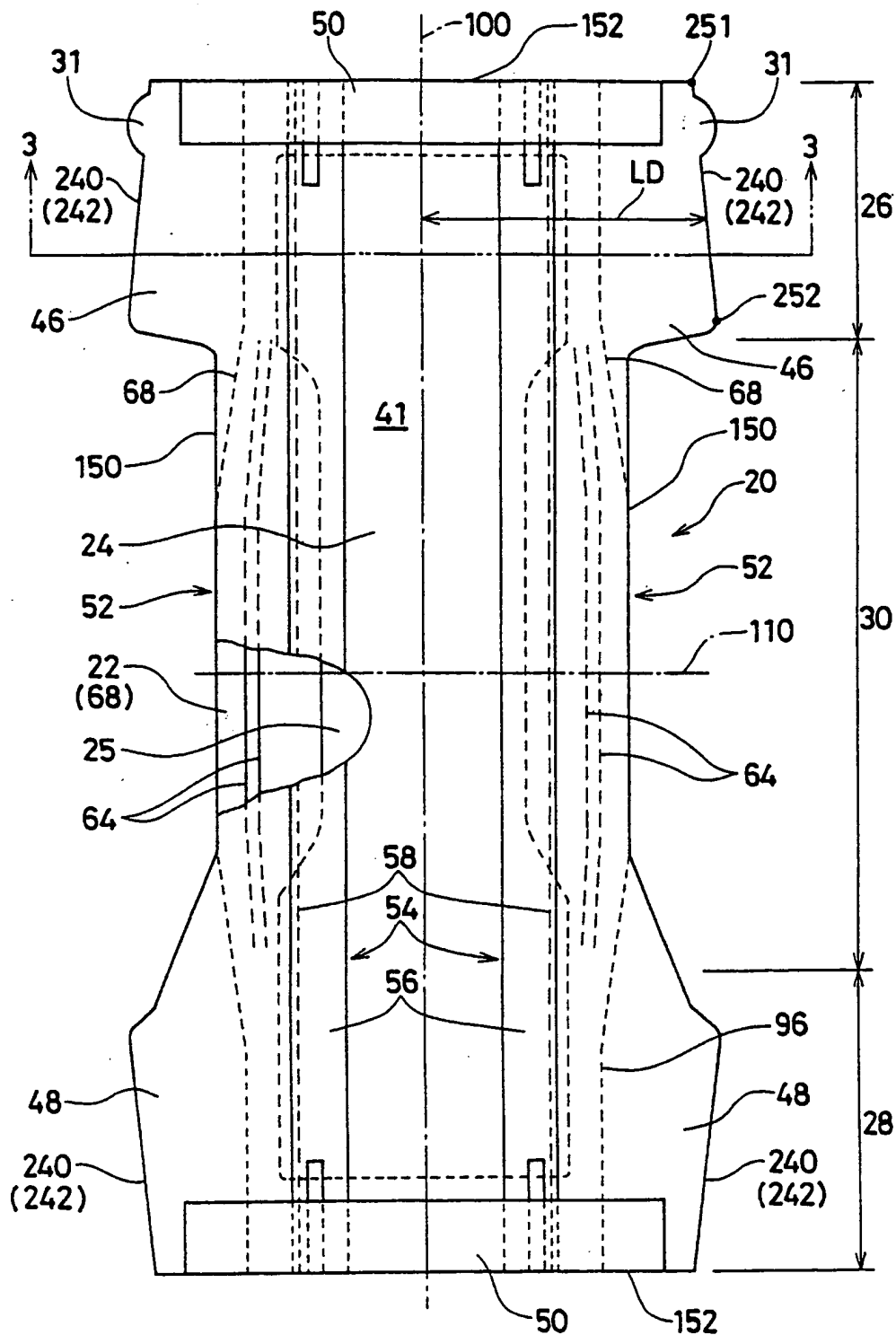


Fig. 2

SUBSTITUTE SHEET (RULE 26)

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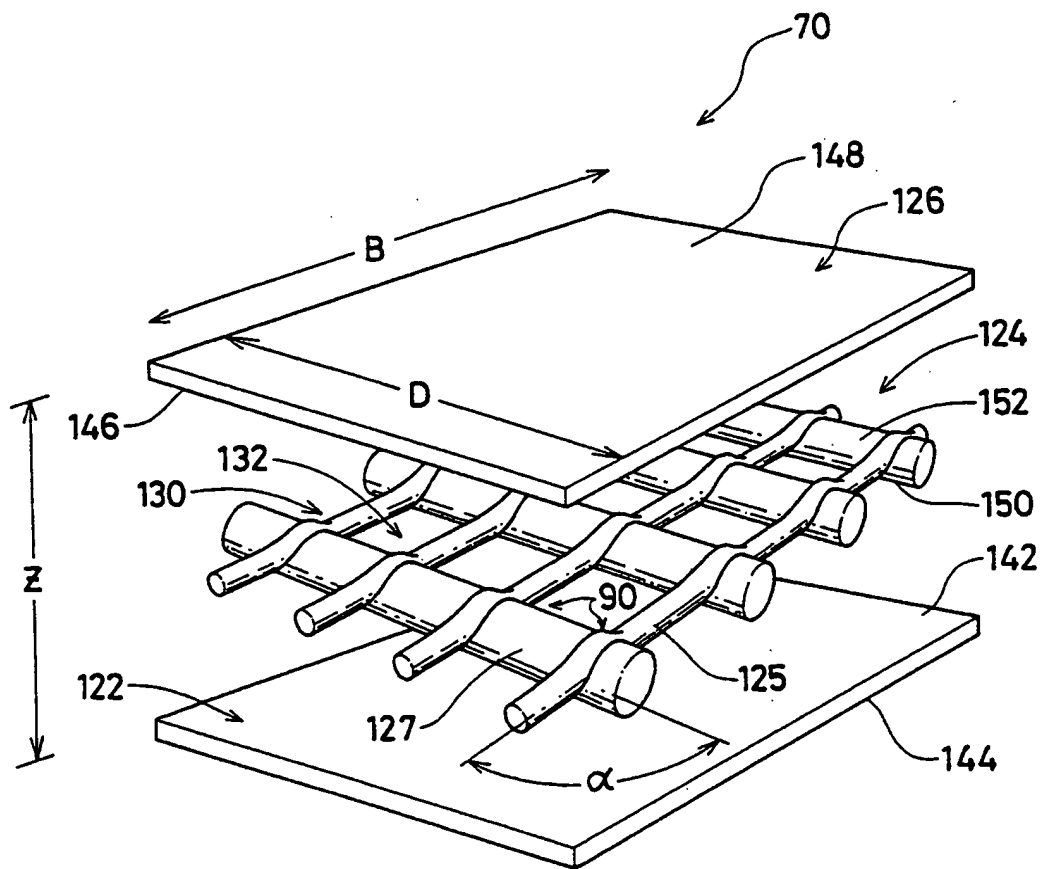


Fig. 4

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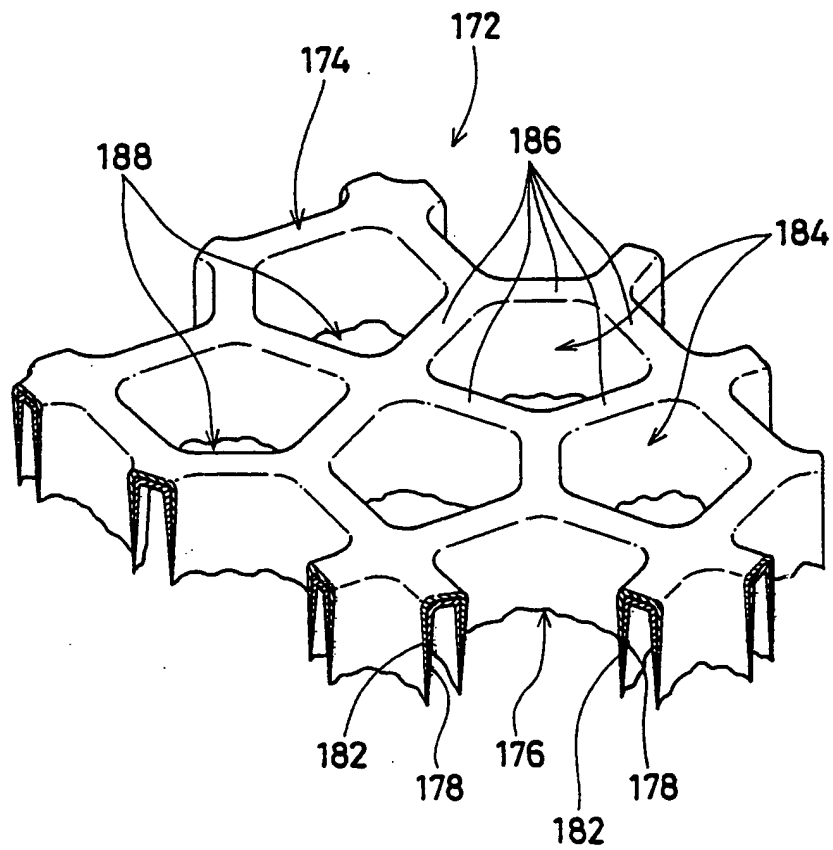
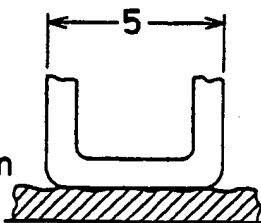
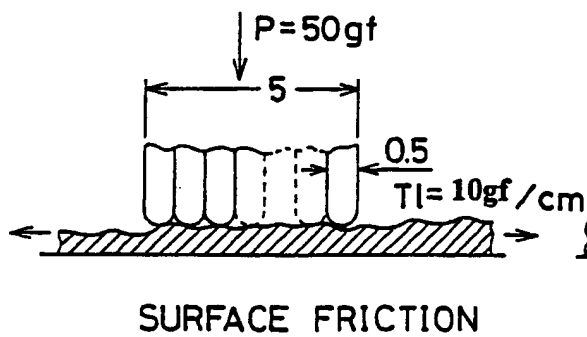
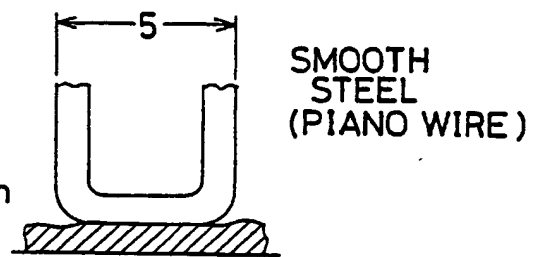
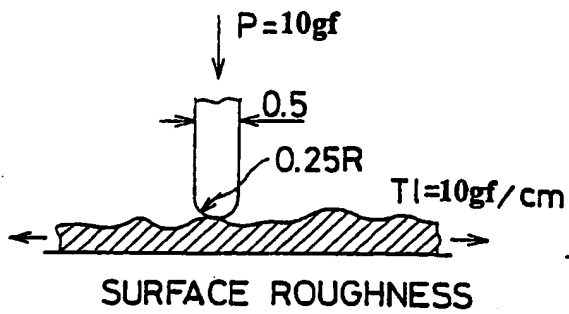


Fig. 5

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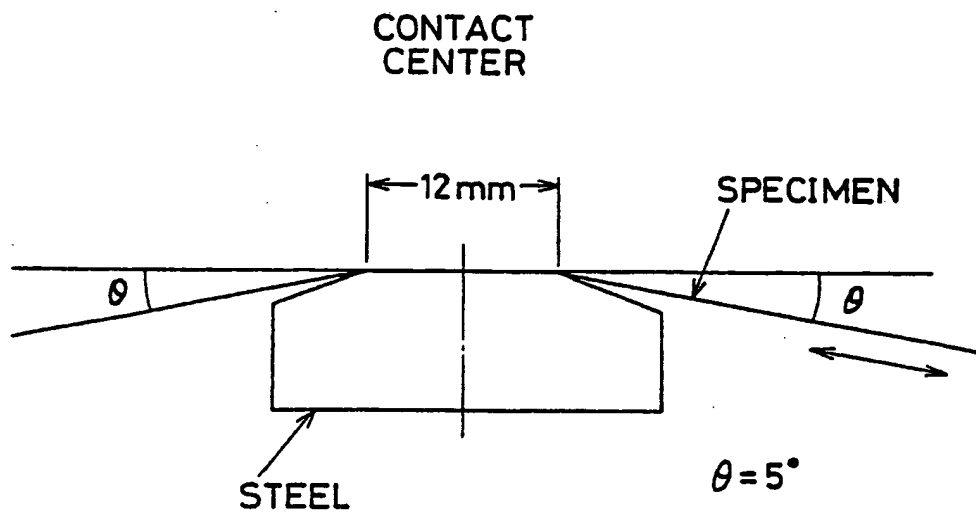


Fig. 9

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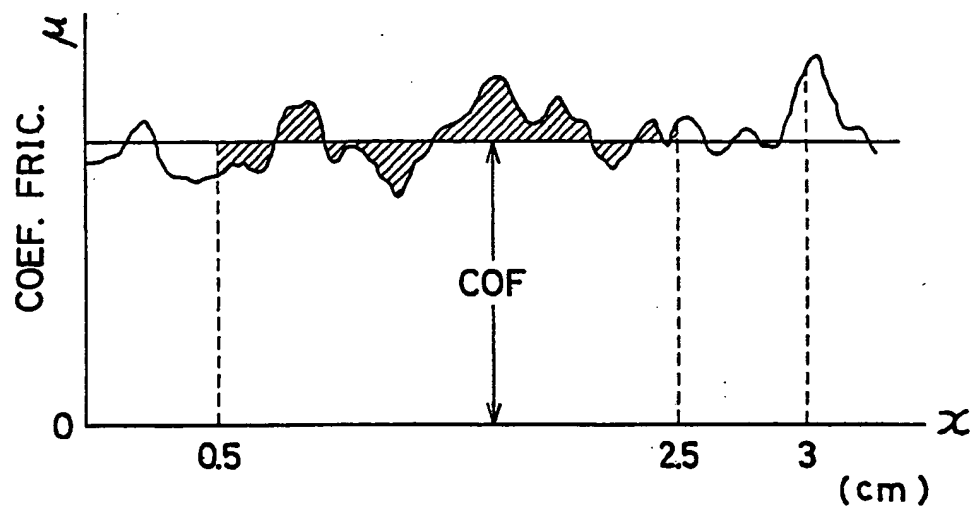


Fig. 10

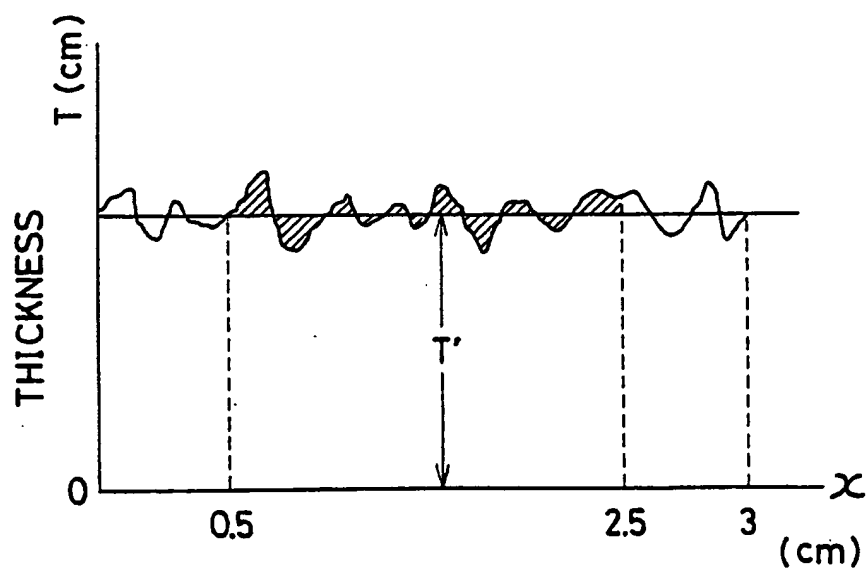


Fig. 11

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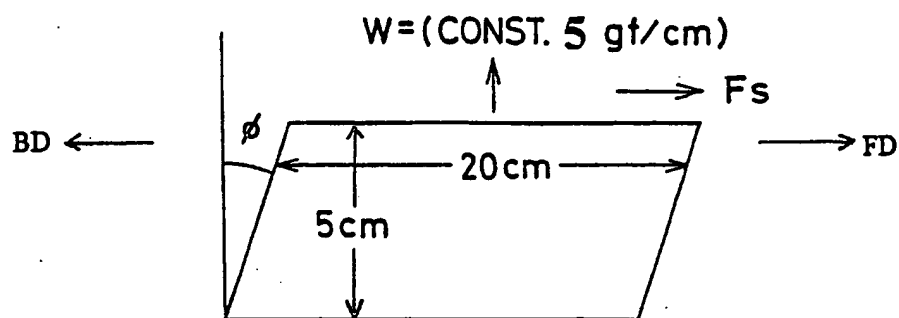


Fig. 12

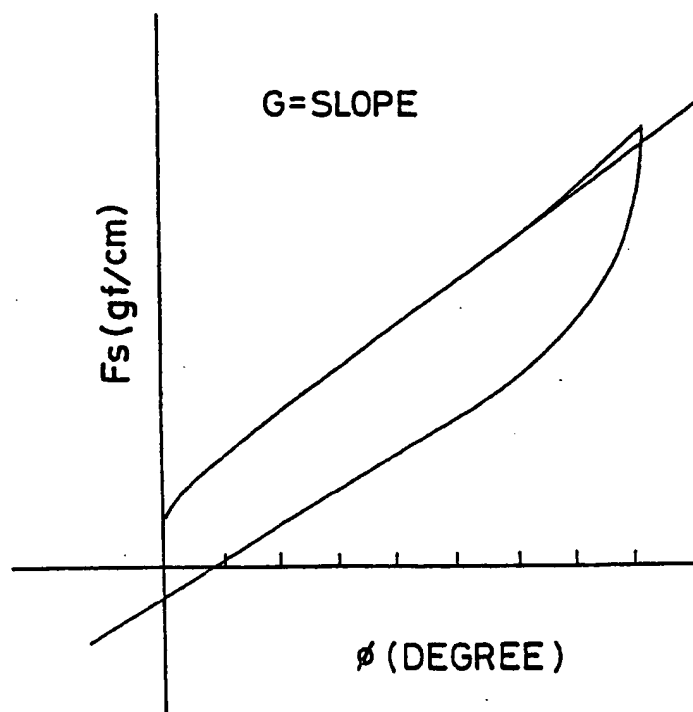


Fig. 13

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 99/24936

A. CLASSIFICATION OF SUBJECT MATTER IPC 7 B32B5/02 D04H13/00 A61F13/15		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC 7 B32B D04H		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) WPI Data, PAJ		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 96 16216 A (FIBERWEB NORTH AMERICA INC ;QUANTRILLE THOMAS E (US); THOMAS HAROL) 30 May 1996 (1996-05-30) page 1, line 2 -page 5, line 3 page 12, line 23 -page 13, line 6 page 14, line 13 - line 35 page 15, line 35 -page 17, line 8 page 18, line 12 -page 20, line 16	1-10
A	WO 96 10481 A (KIMBERLY CLARK CO) 11 April 1996 (1996-04-11) claims 1,2,4,10-12 page 13, line 19 -page 14, line 3	1-10
-/-		
<input checked="" type="checkbox"/> Further documents are listed in the continuation of box C. <input checked="" type="checkbox"/> Patent family members are listed in annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "A" document member of the same patent family		
Date of the actual completion of the international search 7 July 2000		Date of mailing of the international search report 14/07/2000
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 eport, Fax: (+31-70) 340-3016		Authorized officer Ibarrola Torres, O

INTERNATIONAL SEARCH REPORT

International Application No.
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
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